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# LARVAL DEVELOPMENT OF *MACROBRACHIUM LAMARREI* (H. MILNE-EDWARDS, 1837) [ CRUSTACEA : DECAPODA : PALAEMONIDAE ] UNDER LABORATORY CONDITIONS

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ABSTRACT

The paper reports the development of individuals of *Macrobrachium lamarrei* (H. Milne-Edwards) hatched in the laboratory from berried females collected from the Indian Museum Tank and the Dhakuria Lake (Ravindra Sarovar), Calcutta. The observations were made in November, 1975 and April, 1976. The species, common in many parts of India, goes through abbreviated larval history consisting of three larval stages preceding the postlarva. All the larval stages and their parts are described in detail and illustrated. It appears that the November brood takes slightly longer time in development (from extrusion of eggs to hatching and metamorphosis into first post larva) than the April brood. Some morphological differences between the present observations and those made by Rajyalakshmi on material drawn from riverine-estuarine population were noticed.

## INTRODUCTION

Over two and a half dozen species of the palaemonid prawns of the genus *Macrobrachium* Bate, 1868, have been reported from the inland and estuarine waters of India. Of these, larval development in Indian populations has been studied in detail only in four species viz., *M. lamarrei* (H. Milne Edwards, 1837) by Rajyalakshmi (1961), *M. malcolmsonii* (H. Milne Edwards, 1837) by Kewalramani *et al.*, (1973), *M. idella* (Hilgendorf, 1898) by Pillai and Mohamed (1973) and *M. hendersodayanum* (Tiwari, 1952) by Jalihal and Sankolli (1975). In addition to these, there are some records on larval stages of *M. rosenbergii* (de Man, 1879) and *M. rude* (Heller, 1862) by Menon (1938), and of embryonic development in *M. idae* by Nataraj (1947) and Aiyer (1949). Das (1935) also gave an abstract of larval stages of *M. lamarrei*, but he never published the full account.

In the present work, the development of *M. lamarrei* from hatching to post-larval stage has been followed under laboratory conditions. This species occurs very commonly in various freshwater bodies in a major portion of Indian subcontinent. It is also, to some extent, used as food but does not have any established fishery. As mentioned above, Rajyalakshmi (1961) has already published an account of larval development in this species. However, her study material was drawn from riverine populations in the Hooghly river,

presumably, from waters under tidal influence. On the other hand, the present material was obtained from confined freshwaters in Calcutta. This study was undertaken with a view to find out the impact of differences in habitats on the developmental process. The present investigation, though broadly conforming to Rajyalakshmi's findings, also indicated certain notable differences in the developmental pattern.

## Material and Methods

Berried females of *M. lamarrei* were collected from the Indian Museum Tank and Dhakuria Lake, Calcutta, and kept in laboratory aquaria containing water from the same habitat from where the specimens were obtained. The investigations were carried out in two seasons. The first set of observations was made in November 1975, and the second was conducted in April, 1976.

The berried females were fed with cooked rice, and unconsumed food matter was removed about half an hour after feeding was over, to avoid fouling of water. Females in advanced stages of berry were kept singly in glass jars of one litre capacity and containing water from the original habitat. After hatching was over, the larvae were removed from the jars and spent females transferred to another aquarium.

Rearing of larvae was carried out in glass beakers of 250 ml. capacity. Two to three larvae were kept in one beaker with about 150 ml. of pond water and covered on top with fine muslin cloth to prevent dust particles from settling in the beakers. A few examples of each larval stage were preserved in neutral formalin mixed with glycerine (9 : 1). Exuviae were also collected and preserved likewise. Attempt to keep some larvae in tap water did not succeed ; calcium precipitate adhered to setae of their appendages, obstructing the larval movements and leading to mortality.

The larvae were kept at room temperature and water was not artificially aerated, nor were the individuals fed.

Measurements were made wtih ocular micrometer on preserved larvae. Appendages were dissected and mounted in polyvinyl alcohol-lectophenol mixture. Appendages dissected from larval exuviae gave excellent results. All the drawings were made with camera lucida and measurements recorded in millimeters.

## Observations

*General* : In berried females, the pleopods showed constant movements. Though no records were maintained of the frequency of movements, it appeared that there was an increase in the rate of pleopod movements as the time for hatching drew nearer. Feeding of the berried females was necessary. In some cases, where the females were not supplied with food, there was no hatching.

*Eggs* : The eggs in this species are rather large and oblong varying from 1.5 mm to 1.7 mm in longer diameter and 0.97 mm to 0.90 mm along the shorter axis (Fig. 1 A & B). In the early stages they were yellowish green in colour. With the advancement of embryonic growth, they turned yellowish brown.

*Hatching* : Hatching apparently occurred later in the night after 21 hrs., usually in two, occasionally in three, batches. Though in the present observations no egg was seen to hatch during day time, on an earlier occasion, one of us (K. K. T.) had watched the hatching of eggs during day time, around 11 a.m. On this occasion eggs hatched one after another with a time interval varying from about three to

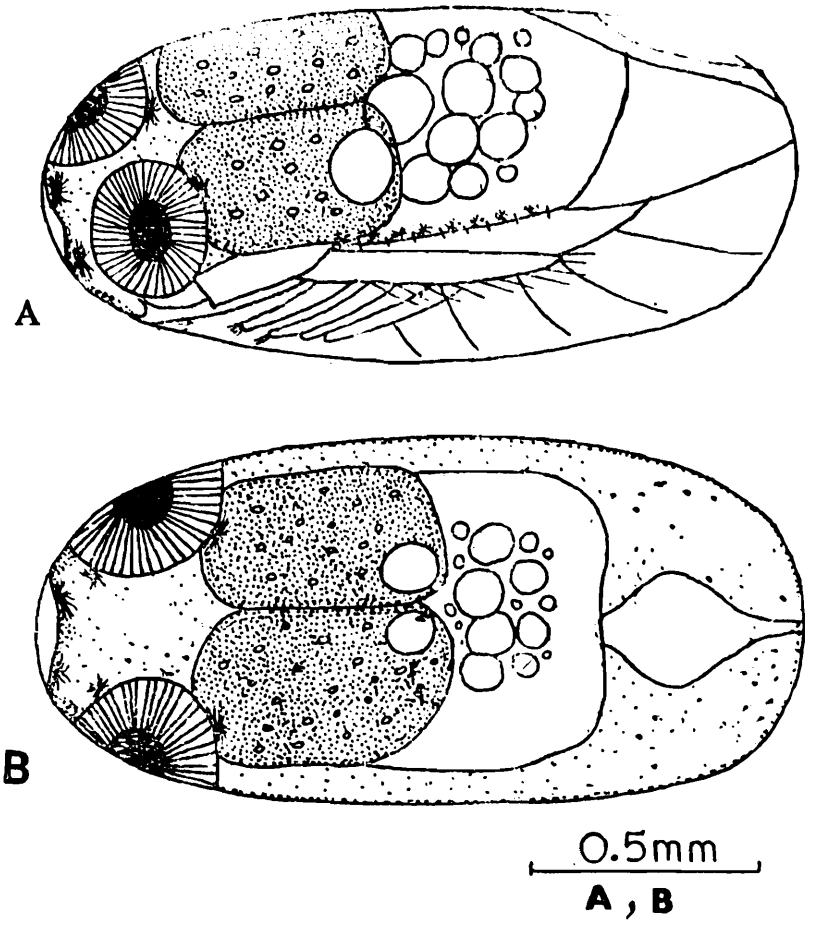


Fig. 1. Egg of *Macrobrachium lamarrei* (H. M. Edw.), before hatching.
A—lateral view ; B—dorsal view.

fifteen minutes. Before the larvae emerged from the eggs, wriggling movements could be observed inside the eggs. On emergence through a tear in the egg membrane, the larvae passively sank to the bottom of the vessel, but within a few minutes they started swimming, settling along the sides of the container or on the undersurface of blades of aquatic weeds kept therein.

There was some seasonal variation in hatching period. In females that came in berry in November, 1975, eggs took 18 to 20 days to hatch after extrusion. In females that berried in April, 1976, hatching was completed in 12 days time. This indicated that perhaps the duration of hatching period is influenced by temperature.

## DESCRIPTIONS OF LARVAL STAGES

### First larval stage (Fig. 2 A-S)

*Average length* : 4.350 mm.

*Description* : Carapace smooth, its antero-ventral edge on each side produced into small pterygostomian spine (Fig. 2 D), large amount of yolk granules present under the carapace ; rostrum unarmed ; eyes sessile ; antennule, antenna and mouth parts developed ; five pairs of pereiopods present, only the last two pairs uniramous, first two pairs of pereiopods chelate and nonfunctional ; abdomen with six segments and with five pairs of pleopods ; telson not separated from 6th abdominal segment (Fig. 2 A-C).

*Antennule* (Fig. 2E) : Antennular peduncle long, slender, and unsegmented ; carrying two flagella, inner one long, slender and plumose, outer stumpy, bearing four aesthetes and one short spine-like pulmose inner seta.

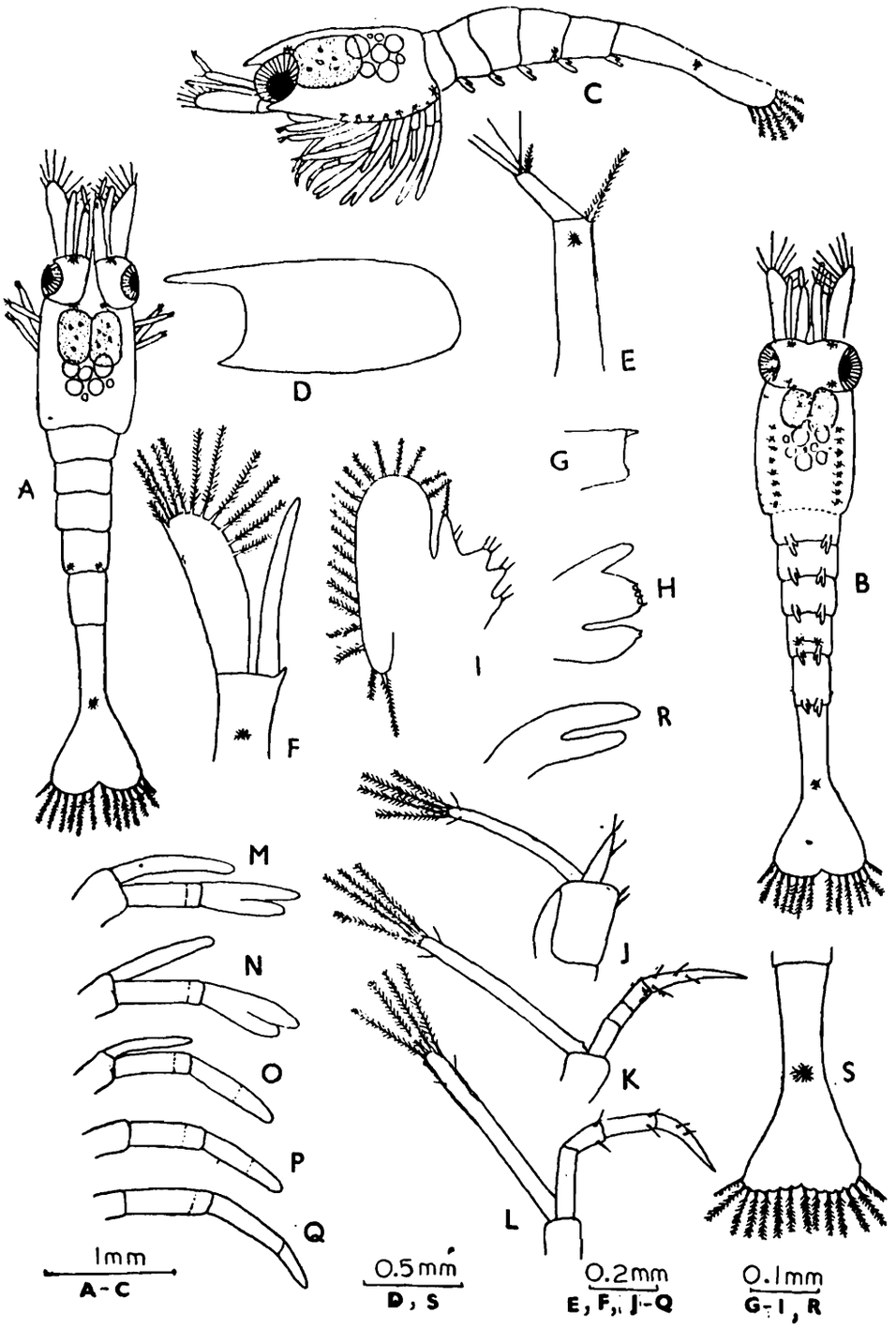


Fig. 2. First Larval Stage of *Macrobrachium lamarrei* A—C larva (dorsal, ventral and lateral views), D. carapace ; E. antennule ; F. antenna ; G. mandible ; H. maxilla I ; I. maxilla II ; J—L. maxillipeds I—III ; M—Q. pereiopods I—V ; R. pleopod ; S. telson.

*Antenna* (Fig. 2F) : Antennal peduncle (endopod) stout, unsegmented process reaching beyond the exopod margin ; exopod distinct, plate like, its inner margin carrying 10 or 11 plumose and a single short plumose setae present at the distal extremity of its external border.

*Mandibles* (Fig. 2G) : Two large prominent structures, no demarcation between the incisor and molar parts ; one sharp tooth in the upper incisor region, molar region almost smooth.

*Maxilla I* (Fig. 2 H) : Three distinct lobes ; endopod smooth, not bifid ; the proximal lacinia carrying two small spines and larger distal lacinia with two large spines on the outer border and two on the inner border.

*Maxilla II* (Fig. 2 I) : Exopod with 19 plumose setae along its margin, the hindmost seta long and directed backwards, endopod with a single seta at its extremity and two small setae at its base ; exopod carrying three masticatory processes, 1st with three setae, 2nd with two and 3rd with one seta and also carries an additional seta, a little lower.

*Maxillipeds* (Fig. 2J-L) : Three pairs of well developed biramous maxillipeds with setose exopodites ; basal segment of 1st maxilliped expanding and carrying short and thick endopodite, a bud like epipodite also present ; maxillipeds II and III almost identical, each with a 4-segmented endopodite, ending in a stout dactylus ; maxilliped II also carries a small epipodial bud.

*Pereiopods* (Fig. 2 M-Q) : Five pairs of pereiopods present ; 4th and 5th pairs without exopodites ; chelae present on 1st and 2nd pairs of pereiopods ; setose exopodites present on only first three pairs of pereiopods ; no spine or setae present on each chela.

*Pleopods* (Fig. 2R) : Small, biramous pleopods present on I-V abdominal segments ; each pleopod having a clear basal segment.

*Telson* (Fig 2S) : Not distinct from 6th abdominal segment ; broad, concave posteriorly, carrying 7 setose spines on either side.

*Chromatophores* : Larva transparent, distal margin of antennular peduncle with reticulate orange red chromatophores ; anterior and posterior dorsal margins of eye with stellate orange red chromatophores and junction of eye and carapace with diffused violet chromatophore located on a bluish background, stellate red chromatophores on the base of each of maxillipeds as well as five pairs of pereiopods ; abdominal chromatophores situated on 3rd abdominal segment (on lateral side) and ventrally on 4th abdominal segment ; an additional dendritic orange red chromatophore situated at the base of telson.

This larva differs from typical zoea larva in having :

(i) unsegmented apex of antennal peduncle (endopod) ;

(ii) buccal structures less differentiated ;

(iii) epipodite present in Maxilliped I ; and

(iv) pereiopods being more advanced.

Second Larval Stage (Fig. 3.A-S)

*Time for 1st moult* : 2-3 days in observation I (in November, 1975). One day in observation II (in April, 1976).

*Length of larva :* 4.4 mm.

*Description :* No significant increase in size, larva having undergone considerable morphological changes (fig. 3A-C) ; carapace with prominent supraorbital and branchiostegal

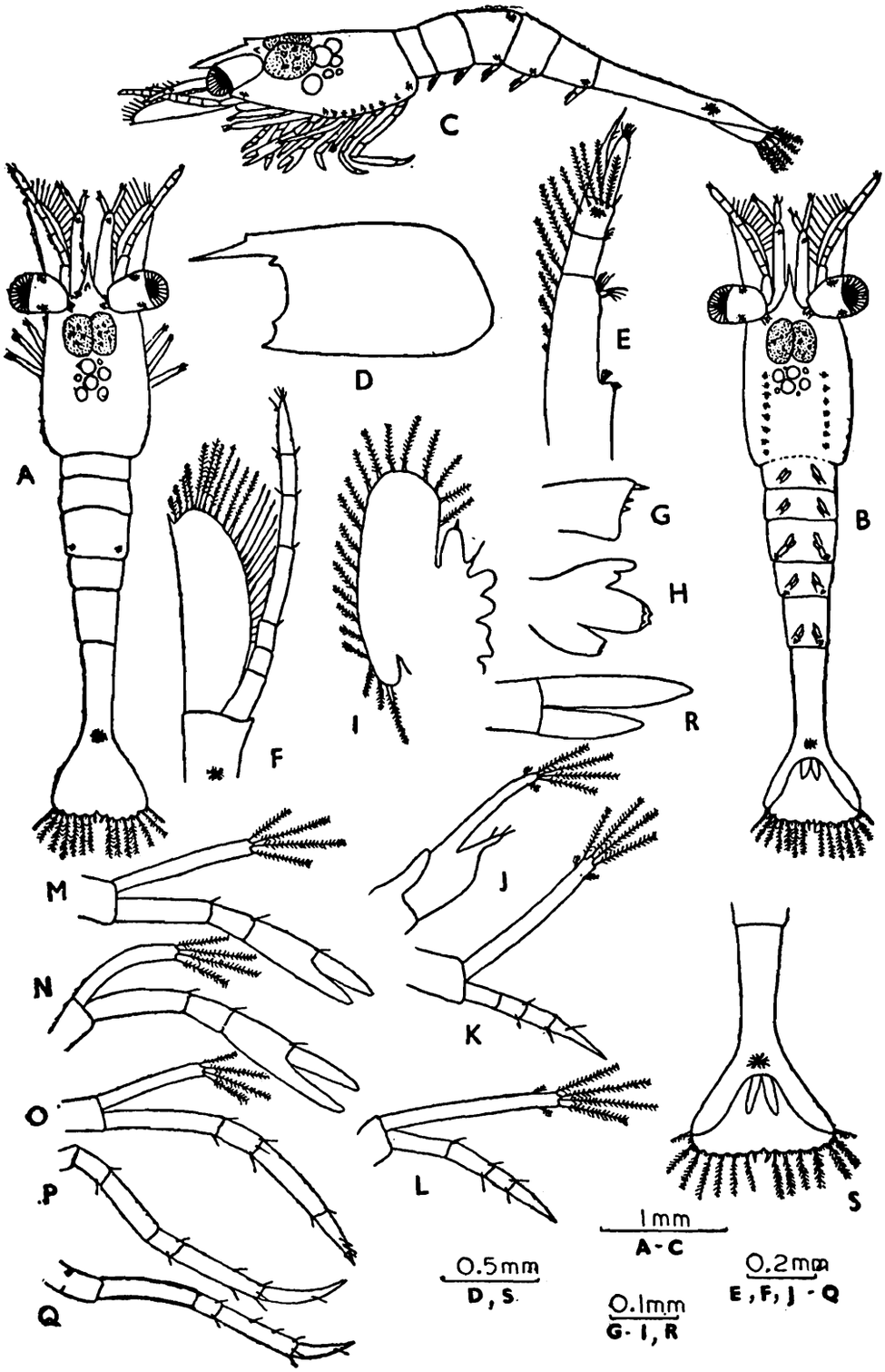


Fig. 3. Second Larval Stage of *Macrobrachium lamarrei* A—C, larva (dorsal, ventral and lateral views) ; D. carapace ; E. antennule ; F. antenna ; G. mandible ; H. maxilla I ; I. maxillaII ; J—L. maxillipeds I-III ; M—Q. pereiopods I-V ; R. pleopod, S. telson.

spines in addition to pterygostomian spine (fig. 3D) ; rostral formula 1/0 ; eyes stalked ; chromatophores at the base of 4th pair of pleopods more prominent ; additional chromatophores developed at the basis of 3rd and 5th pairs of pleopods.

*Antennule* (Fig. 3E) ; Antennular peduncle 3-segmented ; outer and inner flagella unsegmented, outer flagellum with four aesthetes and inner long spine-like setae and two aesthetes ; inner margin of the antennular peduncle withe 13 plumose setae, five of them encircling the terminal segment of peduncle , large number of setae present on all joints on outer margin of peduncle.

*Antenna* (Fig. 3F) ; Antenna showing all characteristic features of the adult appendage ; endopod long and multijointed ; exopodite provided with 24 plumose setae along its inner margin and a distinct spine at the distal extremity on the outer border.

*Mandibles* (Fig. 3G) : Incisor and molar parts still not distinct ; former carrying 2-3 teeth and the latter with only one tooth.

*Maxilla I* (Fig. 3H) : Endopod bifid ; proximal and distal lacinae with four small spines.

*Maxilla II* (Fig. 3 I) : Almost retains the same structure ; 1st and 2nd masticatory processes lacking setae.

*Maxillipeds* (Fig. 3 J-L) : Epipodial bud of maxilliped-I more elongated, endopodites of maxillipeds II and III still 4-segmented ; more spines present on the segments.

*Pereiopods* (Fig. 3 M-Q): Pereiopods showing some movement but still not functional ; segmentation between coxa and basis ischium and merus not distinct ; chelae of pereiopods 1st and 2nd faintly marked ; more setae appearing on the segments of 3rd to 5th pereiopods.

*Pleopods* (Fig. 3 R) : Five pairs of biramous pleopods ; each pleopod 2-segmented.

*Telson* (Fig. 3 S) : Still not distinct from 6th abdominal segment ; carrying 8+8 spines ; one additional small, non-setose spine developed on inner aspect of each side of telson ; outermost spine on each side having setae only on the inner side ; in experiment conducted in November, 1975, the development of inner seta on left side was suppressed in all specimens, resulting in only 7+8 setae ; outlines of developing uropods distinguishable in larvae which were about to moult to next larval stage.

Third Larval Stage (Fig. 4, A-S)

*Time for 2nd moult* : 2-3 days in observation I (November, 1975) 2 days in observation II (April, 1976).

*Length of larva* : 4.51 mm.

*Description* : Carapace with epigastral hump, well developed supraorbital, branchiostegal and pterygostomian spines. (Fig 4D) ; rostral formula 2/0 or 3/0 ; a pair of lateral spines on 5th abdominal segment ; telson separated from 6th abdominal segment; additional reticulate orange chromatophore appearing at the basal segment of antennular peduncle, additional pair of chromatophores developed at the base of 2nd pair of pleopods, that at the base of telson becoming less distinct (fig. 4A-C).

*Antennule* (Fig. 4E) : Antennular peduncle expanded and 3-segmented ; inner flagellum elongated, 3-segmented, carrying 2 aesthetes ; outer flagellum divided into 2 distally ; number of setae encircling terminal segment and that on the inner margin of peduncle almost same.

*Antenna* (Fig. 4F) : No considerable morphological change in antennae ; endopodite

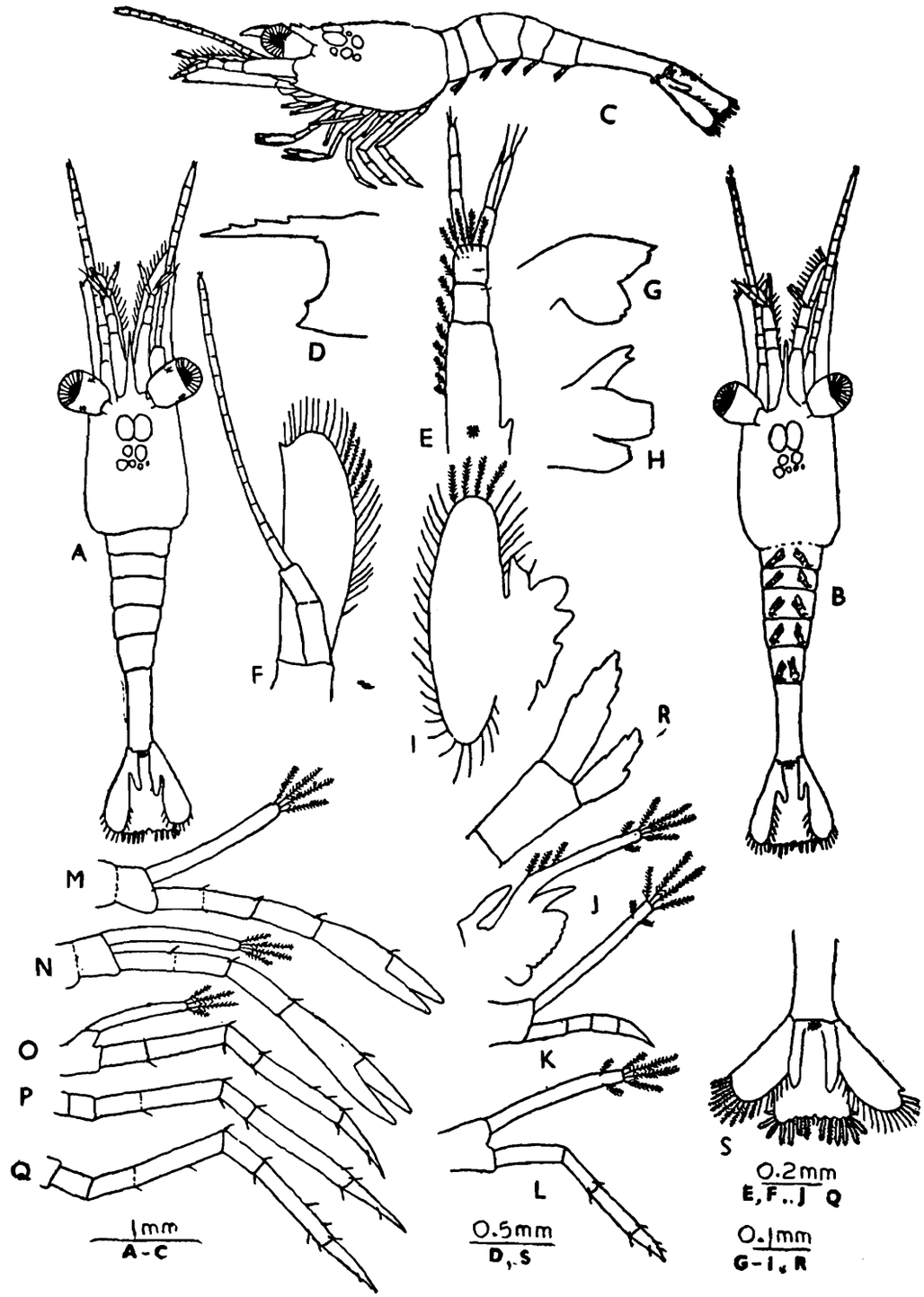


Fig. 4. Third Larval Stage of *Macrobrachium lamarrei* A—C. larva (dorsal, ventral and lateral views) ; D. carapace (anterior end) ; E. antennule ; F. antenna ; G. mandible ; H. maxilla I ; I. Maxilla II ; J—L. maxillipeds I-III M—Q. pereiopods I-V, R. pleopod ; S. telson and uropod.

very long, multi-jointed with large number of setae along its length, 4 setae at the apex of flagellum.

*Mandible* (Fig. 4G) : Considerable morphological changes in the shape of mandibles ; incisor and molar processes marked from

each other ; incisor process with one tooth and three denticles and molar process with two denticles.

*Maxilla I* (Fig. 4H) : Endopod deeply notched ; proximal lacinia with 4 spines and distal with 5 spines.

*Maxilla II* (Fig. 4I) : More plumose setae developed all along the margin of exopod ; endopod without any setae, one seta only at its base ; masticatory prccesses with setae.

*Maxillpeds* (Figs. 4J-L) : Coxa and basis of 1st pair of maxillipeds flattened, leaf-like and projecting inwards, basis bearing a row of projections all along its border ; epipodite still more elongated ; basal part of exopodite slightly flattened and carrying 3 plumose setae along its outer margin ; endopodites of maxillipeds II and III still 4-segmented.

*Pereiopods* (Figs. 4M-Q) : Pereiopods still not functional ; segmentation between ischium and merus not distinct ; in 1st and 2nd pairs of chelate legs, propodus and dactylus clearly demarcated ; claws not bearing spines.

*Pleopods* (Fig. 4R) : An appendix interna making appearance on 2nd to 5th pairs of pleopods ; the outer edges of exopodites and endopodites of each pleopod not smooth.

*Telson and Uropods* (Fig. 4S) : Both demarcated from each other in this stage ; uropod biramous, exopodite larger, with 20 plumose setae at its distal border ; small endopodite not setose ; telson separated from last abdominal segment, less broad and concave at its posterior margin, with 8 + 8 spines at the posterior border.

The larva which emerges out after 3rd moult, has almost all adult characters and represents the post-larval stage.

Fourth Larval Stage :

(Post-larva) (Fig. 5, A-S)

*Time for 3rd moult* : 3 days in observation I (November, 1975). 2 days in observation II (April, 1976).

*Total length* : 4.78 mm.

*Description :* Carapace with an epigasteral hump, well developed supraorbital, branchiostegal and pterygostomian spines (Fig. 5D), small amount of yolk granules still left under the carapace ; rostrum elongated, rostral formula 4/0 or 5/0 and 1, 2 small plumose setae under 5th rostral tooth and one under 3rd tooth ; articulation of telson with 6th abdominal segment well defined, uropods developed ; orange red chromatophores on eye peduncle, and also in the epigastric region of carapace ; chromatophores also developed at the bases of all pairs of pleopods while that situated at the base of telson becomes less distinct (Fig. 5A-C).

*Antennule* (Fig. 5E) : Statocyst seen at the expanded base of antennular peduncle, sensorial setae arranged themselves along a circular arc on statocyst ; inner flagellum multi-jointed, carrying 2 terminal setae ; outer flagellum divided into 2 branches, outer branch 4-segmented and carrying 3 setae, inner branch terminating in an aestheta and carrying one lateral aestheta and 2 terminal setae ; 13 long plumose setae on the inner surface of antennule.

*Antenna* (Fig. 5F) : No significant morphological change in antenna ; antennal peduncle(endopod) carrying more plumose setae ; exopod (flagellum) becomes more elongated and multi-segmented.

*Mandible* (Fig. 5G) : Incisor and molar parts distinct ; 3 teeth on the molar process and 5 on the incisor process,

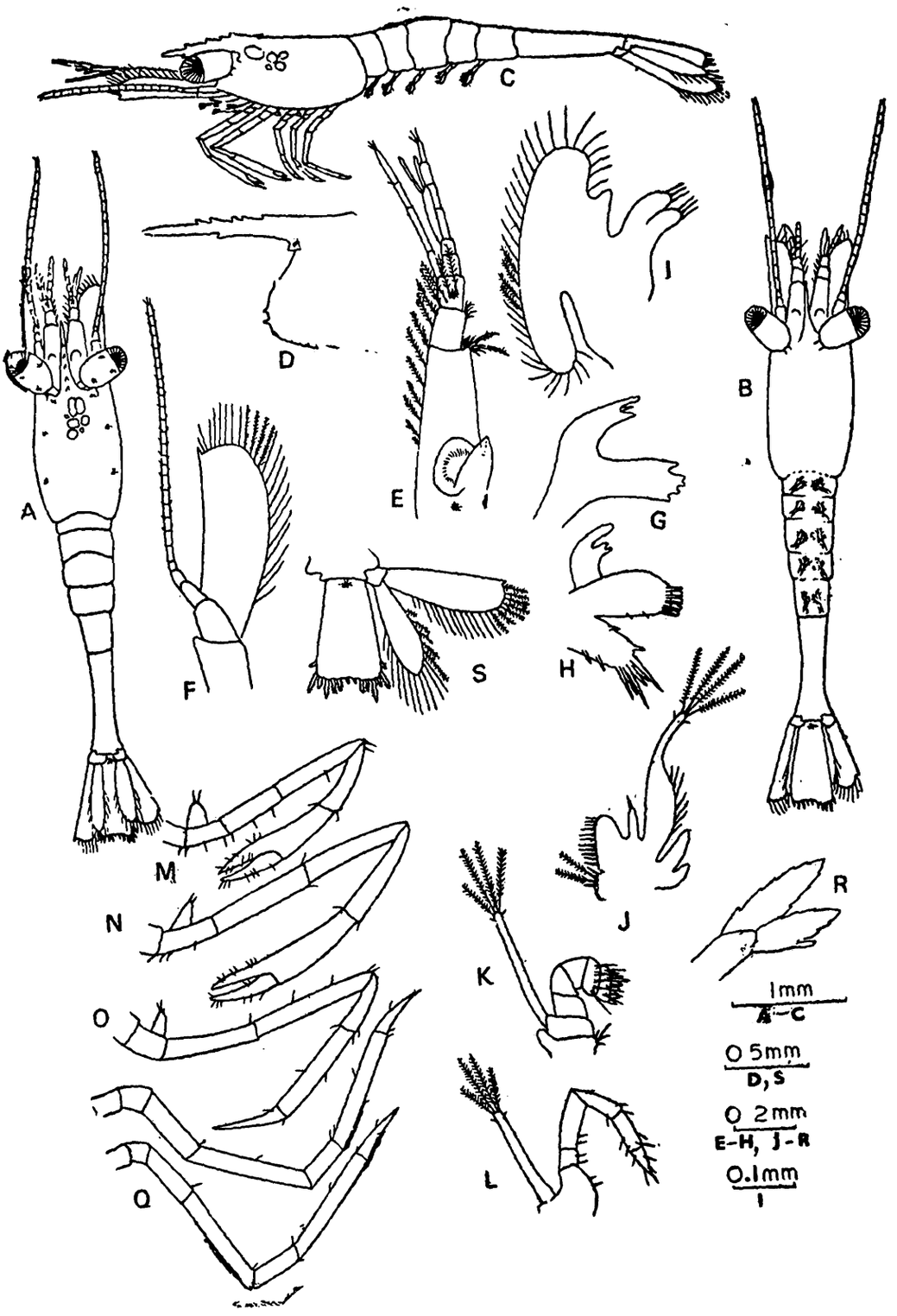


Fig. 5. Fourth [Stage (Post-larval Stage) of *Macrobrachium lamarrei* A—C, post-larva (dorsal, ventral and lateral views) ; D. carapace (anterior part) ; E. antennule ; F. antenna ; G. mandible ; H. maxillla I. I. maxilla II ; J—L. maxillipeds I-III, M—Q. pereiopods I-V ; R. pleopod ; S telson and uropod.

*Maxilla I* (Fig. 5H) : Distal lacinia with 8 stout teeth and 2 marginal spines ; proximal lacinia with 6 teeth and 3 marginal spines.

*Maxilla II* (Fig, 5I) : Exopod of maxilla II with more plumose setae ; endopod simple and bare, basis with endites each terminating into 3 bristle-like setae.

*Maxillipeds* (Fig. 5J-L) : Basis of maxilliped I with 18 short setae and 2 plumose setae, endopodite small and bearing a single seta apically, base of exopodite expanded and bearing 7 plumose setae, epipodite bilobed ; endopodite of maxilliped II 5-segmented, propodus and dactylus broad and bearing several setae ; endopodite of 3rd pair of maxillipeds also 5-segmented and profusely setose.

*Pereiopods* (Figs. 5M-Q) : Segmentation in pereiopods distinct ; exopodites on 1st, 2nd and 3rd pairs of pereiopods very much reduced ; chelipeds I and II showing setae on their segments ; chelae with well developed sharp terminal claws, no teeth visible on their inner margins (edges).

*Pleopods* (Fig. 5R) : All pairs of pleopods biramous ; exopodites and endopodites carrying long plumose setae all along their distal borders ; appendix interna still bud like.

*Telson and Uropods* (Fig. 5S) : Each uropod biramous, exopod with 13 and endopod with 6 plumose setae, telson longer, broader at posterior end and bearing five spines and one lateral spine on either side.

## DISCUSSION

As regards the larval development, the genus *Macrobrachium* exhibits three different patterns :

(i) Prolonged larval history : With large number of small-sized eggs and larval history having a large number of free swimming larval stages (8-16 zoeal stages) e.g., *M. rosenbergii*, (Ling and Merican, 1961 ; Ling 1969 ; Uno and Kwon,1969), *M. carcinus*,(Lewis, 1961 ; Lewis and Ward, 1965 ; Chaudhury, 1971), *M. nipponense*, (Kwon and Uno, 1969), *M. acanthurus*, (Chaudhury. 1970), *M. malcolmsonii* (Kewalramani *et. al.*, 1970), *M. formosense* (Shokita, 1970), *M. niloticum* and *M. intermedium*, (Williamson, 1972), *M. idella*, (Pillai and Mohamed, 1973).

(ii) Abbreviated larval history : With comparatively larger sized and lesser number of eggs than in the first type and also with lesser number (three) of free swimming larval stages e.g., *M. lamarrei*, (Rajyalakshmi, 1961), *M. australiense*, (Fielder, 1970).

(iii) Nearly suppressed larval history : With eggs generally larger than in the second type and lesser in number, larval stages minimum, the larvae on hatching without functional legs and resemble postlarva or adult e.g., *M. potuina*, (Sollaud, 1923) *M. shokitai*, (Shokita, 1973) and *M. hendersodayanum* (Jalihal and Sankolli, 1975).

The larval development of *M. lamarrei*, as mentioned earlier, fits in the second category. The larvae hatch out with a few characters of normal zoea and many of those of advanced larva and they need only three moults to enter the postlarval stage. This type of abbreviated development has also been pointed by Fielder (1970) in *M. australiense*, which also showed three larval stages.

The larvae of Palaemoninae were described by Sollaud (1923) under two groups. To the first group belonged the normal zoea and the second group larvae were termed as hypomysis, with again two phases *i.e*, 'subparva' and 'preparva'. The larvae which

hatch out in *M. lamarrei* are similar to Sollaud's 'subparva'. In this species the newly hatched larvae have five pairs of immobile feet which lie folded on the ventral side of carapace. However, exopodites of all the maxillipeds and endopodites of maxillipeds II and III serve in locomotion. The latter function as feet only after the first larval moult and mark the beginning of the 'Mysis phase', but the chelipeds become functional only after the third and final moult. Moreover, the suppressed development of all buccal organs in these larvae can be correlated with the presence of sufficient amount of reserve food material due to which the larvae do not have to depend upon the external food supply. On the other hand, the differentiated scaphognathite of Maxilla II helps to produce a respiratory current in the branchial chamber right from the time of hatching.

The present observations are in general conformity with findings of Rajyalakshmi (1961) though there are some differences in details. For example, the size and shape of eggs in the populations presently studied are somewhat different from those described by Rajyalakshmi. In our specimens, eggs were rather oblong, and not oval and their longer diameter was more (1.5 mm to 1.7 mm ; average 1.6 mm) than in other population (1.33 mm to 1.45 mm ; average 1.36 mm). However, Koshy and Tiwari (1975) gave the average length of eggs as 1.32 mm.

It has already been remarked that the embryonic development (the time between extrusion of eggs and their hatching) took longer time i.e., 18 to 20 days, in November, 1975 brood, than in April, 1976 when this period was reduced to 12 days only. In the material studied by Rajyalakshmi this interval varied from 12 to 14 days, corresponding roughly with the April brood. In the larval development also the same differences are noticed. In the population studied in November, 1975, the larval development (from hatching to third moult) took 7 to 9 days but in April brood, it took only five days. Rajyalakshmi's specimens went through three moults in about four days time, again agreeing with the present summer observations.

Though the number of observations are not sufficient to make any generalisations, apparently temperature seemed to play some role in development. In November, 1975, when the temperatures were somewhat lower, the entire developmental process from the extrusion of eggs till the emergence of post-larva took about 3-4 weeks, while in April, 1976, it was completed in less than three weeks.

In addition, certain morphological differences are noticed in the larval development in the present observations and those of Rajyalakshmi. These are tabulated below :

| **Present observation** | **Rajyalakshmi (1961)** |
|---|---|
| 1. *1st Larval Stage* | 1. *1st Larval Stage* |
| (i) Antennary flagellum unsegmented. | (i) Antennary flagellum 3-segmented at basal region ; |
| (ii) endopod of maxilla I, smooth ; | (ii) endopod of maxilla I bi-fid ; |
| (iii) endopodites of maxillipeds II and III, 4-segmented ; | (iii) endopodites of maxillipeds II and III, 5-segmented ; |
| (iv) 4th and 5th pairs of pereiopods uniramous. | (iv) only 5th pair of pereiopods uniramous. |
| 2. *2nd Larval Stage* | 2. *2nd Larval Stage* |
| (i) Carapace with supraorbital, branchiostegal and pterygostomian spines. | (i) only first two types of spines present ; |

| | |
|---|---|
| (ii) inner and outer flagella of antennule unsegmented ; | (ii) inner flagellum 2-segmented and outer flagellum 3-segmented ; |
| (iii) rostral formula : 1/0 ; | (iii) rostral formula : 2/0 |
| (iv) 4th and 5th pereiopods uniramous ; | (iv) only 5th pair of pereiopods uniramous ; |
| (v) endopodites of maxillipeds II and III still 4-segmented ; | (v) endopodites of these maxillipeds 5 segmented ; |
| (vi) telson carrying 8+8 setae but 7+8 setae observed in all specimens in observation I (November, 1975). | (v.) telson carrying 8+8 setae ; |
| (vii) additional chromatophores developed. | (vii) chromatophores same as in larva I. |
| 3. *3rd Larval Stage* | 3. *3rd Larval Stage* |
| (i) carapace with supraorbital, branchiostegal and pterygostomian spines ; | (i) ? |
| (ii) epigastral hump on carapace noticed ; | (ii) no epigastral hump ; |
| (iii) rostral formula : 2/0 or 3/0 | (iii) rostral formula : 2/0 ; |
| (iv) endopodites of maxillipedes II and III 4-segmented ; | (iv) endopodites of maxillipeds 5-segmented ; |
| (v) segmentation of endopodites on all pereiopods not distinct ; | (v) segmentation quite distinct ; |
| (vi) telson spines : 8+8 ; | (vi) telson spines : 7+7. |
| 4. *4th Stage (Post-Larva)* | 4. *4th Stage (Post-Larva) :* |
| (i) in carapace, branchiostegal and pterygostomian spines more distinct ; | (i) ? |
| (ii) epigastral hump on carapace ; | (ii) no epigastral hump ; |
| (iii) rostral formula : 4-5/0—1 ; | (iii) rostral formula : 4/0—1 ; |
| (iv) upper rostral teeth having plumose setae below them ; | (iv) no plumose setae recorded or figured ; |
| (v) small amount of yolk granules still present ; | (v) yolk granules exhausted ; |
| (vi) in maxilliped II, joint between ischium and merus of endopodite distinct. | (vi) joint not distinct. |

Some of the differences seem to be more than individual variations and probably reflect the genetic diversity resulting from diversity in habitats. It has been suggested by Gurney (1942) that land-locked populations tend to favour abbreviated development and the amount of yolk in the eggs have great influence on the course of development. This abbreviation in larval life leads to suppression of exopods on all legs. In Rajyalakshmi's material only the exopods on last pairs of pereiopods were suppressed. In the populations studied by us, on the other hand, the suppression of exopod in larvae extended to the fourth pair of pereiopods also. As has already been mentioned, our material is drawn from populations inhabiting confined freshwaters in Calcutta with ecological characteristic different from those in the estuarine-riverine habitat from where Rajyalakshmi's study material was collected. It apparently seems to lend weight to Gurney's hypothesis.

*Macrobrachium lamarrei* is wide spread in

India occupying large variety of ecological niches i.e., fluvial, lacustrine and estuarine. Yet very little work, particularly at infra-specific level, has been done on populations of this species to ascertain the population dynamics, genetics and related biological problems connected with temporal and spatial attributes. The differences observed here by us in the development of two populations from the same geographical area, but from different habitats, suggest that such investigations could be scientifically very rewarding.

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